

TECHNICAL APPRAISAL

FOR

MICRO HYDRO PROJECT PROPOSAL

IN CHUA VILLAGE

MANICA DISTRICT, MANICA PROVINCE

A Project between GTZ-AMES and Kwaedza Simukai Manica

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TECHNICAL APPRAISAL FOR PREPARATION OF MICRO HYDRO PROJECTS IN CHUA VILLAGE IN MANICA PROVINCE

1) INTRODUCTION

Chua Village is situated in the localidade of Maridza in Manica District, Manica Province. It has 535 households and an estimated total population of 2,360 people.

The village has had experience with micro hydro power for milling for over 30 years. The oldest scheme that was registered in the village was owned by a white settler-farmer (Mr. Johnson) who settled in the area in the 1960's. The scheme was used for driving a maize mill during the day and generating electricity at night for farmer's homestead.

A participatory survey was carried out in Chua Village between 9th and 28th July 2007 and it focused on the potential for improvement of micro hydro power for milling and electricity generation with technical options and interventions on selected sites and operational requirements. The survey involved the owners, village leaders and staff from KSM.

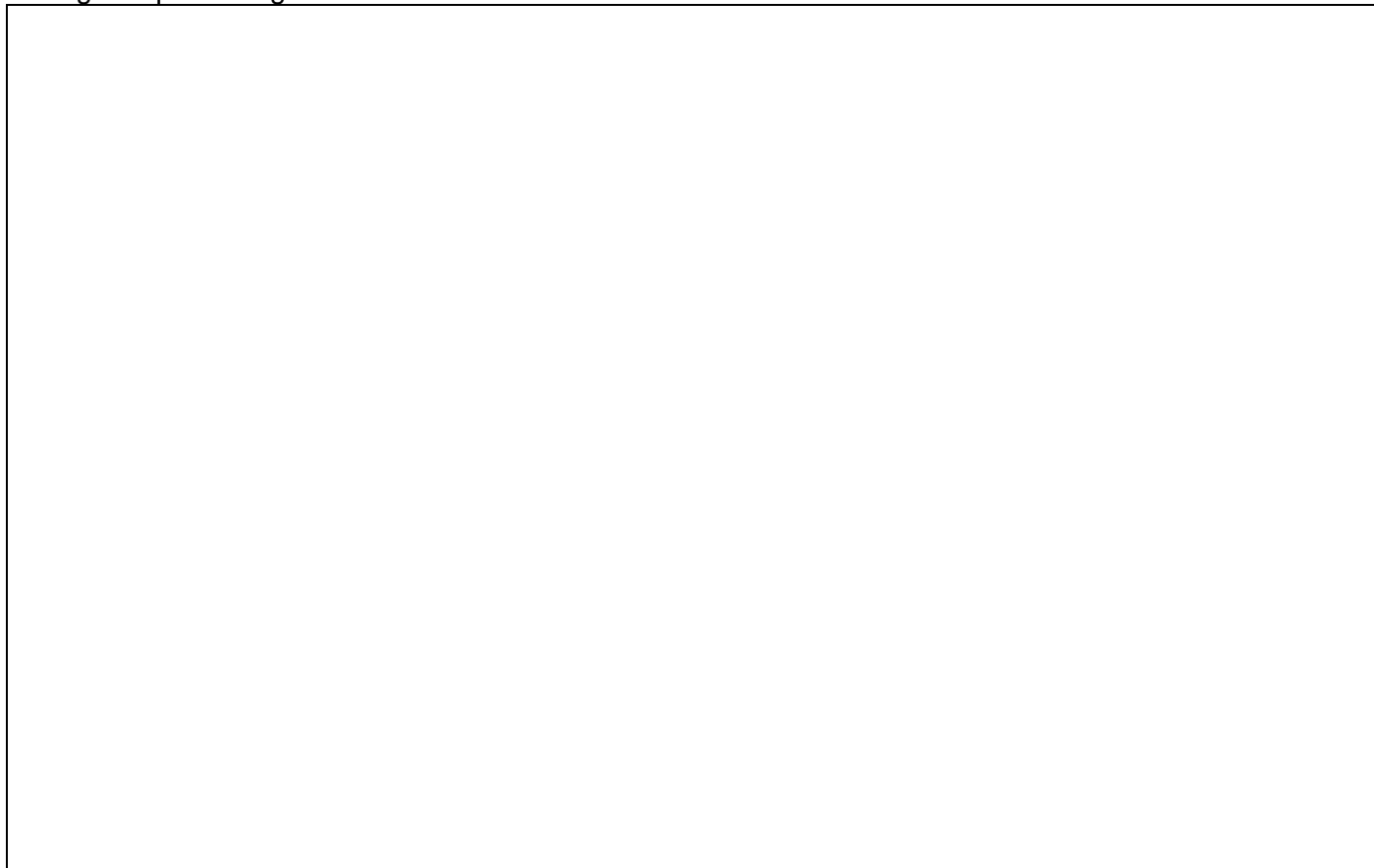
In total eight sites with micro hydro powered maize mills were visited with the main objective to assess the viability to add the component of electricity generation.

The sites that were visited and assessed are listed below:

	Owner
1	Tomas Nguarai
2	Cefas Mucheca
3	Lino Ndacada
4	Jimi Pondo Mucheca

	Owner
5	Estevao Benjamin Mucheca
6	Lucas Mucheca
7	Cefas Mucheca
8	Daniel Muamuca

Village Map showing locations of the maize mills

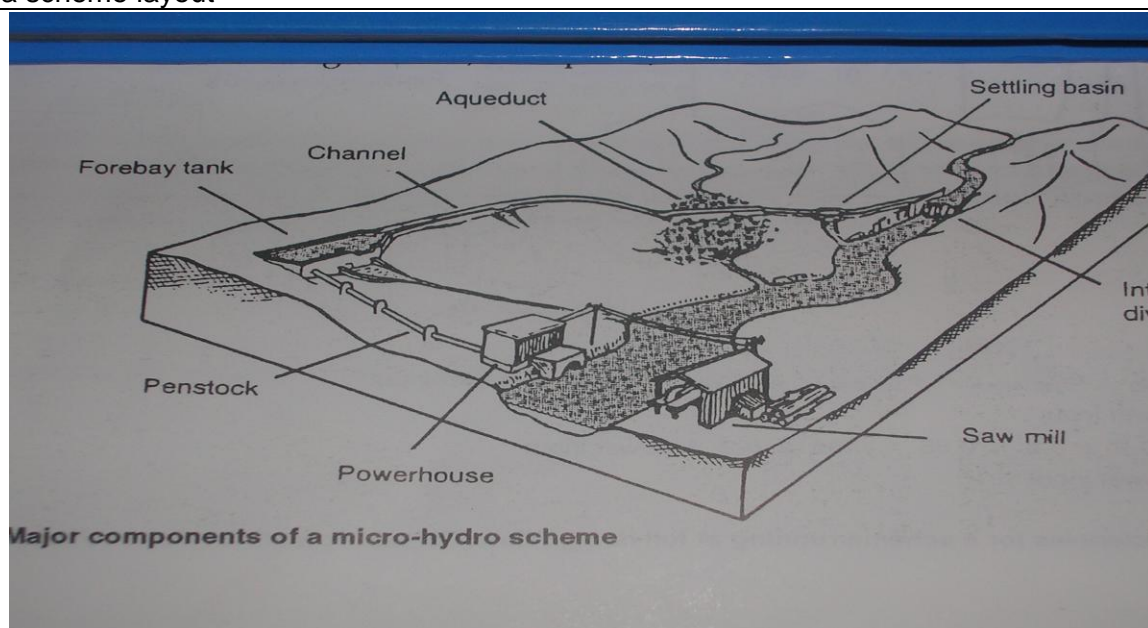


2) DESCRIPTION OF THE TECHNOLOGY

All the machines that were visited used the same type of technology of:

- Small weir diverting water from a stream
- Canal transporting water to the forebay tank
- Forebay tank sunk in the ground
- Penstock on a steep slope leading the water to a turbine.
- Because of the steep slope the water has high pressure when it hits the turbine thereby turning the turbine
- The turbine is linked to a shaft that drives the maize mill through a flat belt.

Sketch of a scheme layout



3) RESULTS OF THE TECHNICAL ANALYSIS

A detailed analysis of the potential was carried out in Chua Village by measuring the availability of water and the flowing speed, the head between forebay tank and turbine, conditions of existing equipment, potential mechanical and electrical energy generation, existing management system, number of beneficiaries and economic potential for multipurpose use.

Detailed results of the survey are in the Annex1.

Summary results are as follows:

	Name of owner	Water flow (Q) in lts/sec	Head (H) in mtr	Power in kW	Directly connected Houses	Houses benefiting from battery charging	Total No. of Houses Benefiting	Total No. of Persons
1	Tomas Nguarai	56,0	59	15,9	30	50	80	480
2	Cefas Mucheca	6,7	48	1,6				
3	Lino Ndacada	60	48	14,7	25	50	75	450
4	Jimi Pondo Mucheca	20	50	8,0	10	20	30	180
5	Estevao Benjamin Mucheca	50	95	22,7	30	50	80	480
6	Lucas Mucheca	20	42	4,3				
7	Cefas Mucheca	20	42	4,6				
	Total				95	170	265	1590

4) SOCIO ECONOMIC VALUES

The analysis included an assessment of the attitudes of the operators and users in terms of business opportunities for multipurpose use of each site. Out of the eight sites four operators were found to be very keen to increase their business opportunities by adding the electricity generation components.

The villagers are rural farmers who grow cash crops like vegetables, ginger, onions, garlic, banana and sugar cane for sale in Manica. There are farmers who make an average of about 50,000 Mt per annum. Although most of the farmers interviewed have priorities of investing in their children's education in form of school fees especially secondary school level, they express the desire to have electricity.

An average of 15% of the villagers use solar panels and car batteries as power for radios and some even for TV's. This is an indication of already existing demand for electricity.

Although most of the villagers (75%) expressed willingness to pay for the electricity they were very reluctant to express the amount of their disposable income that they could set aside for such additional expenses.

One of the farmers, Mr. Marondo a retired teacher who now lives in the village as a farmer, who was interviewed in detail said "This place could be much more developed if only the village could have electricity"

5) CONCLUSIONS AND RECOMMENDATIONS

The overall conclusion is that there is a big potential to promote micro hydro electricity power by improving the existing micro hydro milling machines.

There are a number of advantages linked to this idea and namely:

- ✓ Existing knowledge of operation micro hydro powered maize mills
- ✓ The technology is simple and easily adapted to the local conditions in terms of physical features and level of skills of the manpower.
- ✓ The potential market for electricity generation is high enough to support this type of capital investment.
- ✓ The schemes are environmentally friendly without pollution like carbon dioxide.
- ✓ There are no large civil works necessary like construction of dams or huge canals.
- ✓ No fuel is required to run the system
- ✓ Maintenance costs are low compared to other systems like diesel generators.

As recommendations the following possible intervention options and strategies should be adopted:

- Based on agreed selection criteria of minimal necessary hardware costs and technical interventions, select three or four sites with maximum benefit from improved milling and new electricity services for support by AMES-M.
- Include a micro financing credit scheme that allows a high percentage of cost sharing by operators in order to maintain the ownership spirit. The micro financing scheme can be managed directly by KSM. GAPI SARL which provides credit to small and medium enterprises should also be considered as a potential partner for the future. The advantage of GAPI compared to other MFIs is that the interest rate is low (2% per month compared to 6% per month by ProCredit and even more by SOCREMO). Decisions for credits of up to 120,000 mt. are done at provincial level. GAPI has experience in giving credits for agricultural processing machines like maize mills and oil presses. GAPI has also an added advantage of having worked with German Organisations, vis-à-vis it is working with KFW funding and Fredrich Ebert Stiftung.
- Involve local companies like Metalurgica to fabricate improved systems that are robust and durable. The Director of Metalurgica expressed keen interest to take part on the programme. Unfortunately currently there is a shortage of a draftsman to assist with the designing and costing of items. The company is currently looking for a qualified draftsman.
- Train the operators on business management. The operators will be trained on basic business planning, costing and bookkeeping. This should be based on already existing training manuals that are being used by KSM.
- Train local mechanics on installations, maintenance and repair of the systems. The training should take place during the fitting of the systems. At least 4 local artisans should be trained on installation

- and repair of mechanical equipment and 2 artisans on electrical installations and repairs. A local Electrician was identified during the survey, namely Felix Samuel who used to work for Benicon.
- Involve professional service providers in the planning, designing and supervision of the implementation of the systems. Each scheme should be designed in detail for reference and duplication in future expansion and extension of the projects.

6) JUSTIFICATION OF THE SELECTIONS

The selection criteria that were used for selecting the sites are as follows:

- ◇ Attitude of some of the owners was positive towards business expansion by generating and selling electricity to the neighbours.
- ◇ The maize mills that are already well functioning and there is no need to introduce new sites
- ◇ The technical interventions will require minimal hardware costs thereby reducing the project investment costs
- ◇ The competition of milling operations has already reached a stage where some of the operators are seeking for innovations to expand their businesses.
- ◇ A high number of households have the willingness and ability to pay for electricity services
- ◇ The operators are credit worthy as per MFI specifications

Based on the above selection criteria four sites were selected as follows in their order of preference:

No.	Owner and Recommended technical interventions	Justification of the selection
1	<u>Tomas Nguarai</u> Improve turbine to be robust and strong. Add an electricity generator of up to 12 KW. Install a battery charging station to benefit 50 households and connect directly to 30 nearby houses	<ul style="list-style-type: none"> ○ The operator is an originator of the milling idea who has very positive attitude towards expanding his family business. ○ Good water supply (56 l/sec) and high head (59 m) that gives adequate power to cover local demand ○ Although not very close to the potential benefiting houses a battery charging station will increase the business.
2	<u>Estevao Benjamin Mucheca</u> Improve maize mill and turbine to be robust and strong. Add an electricity generator of up to 15 KW to be connected to 30 nearby houses and also run a battery charging station to benefit 50 households	<ul style="list-style-type: none"> ○ Attitude of owner towards business expansion is positive ○ Good water supply (50 l/sec) and high head (95 m) that gives adequate power to cover local demand ○ Closeness to benefiting households – 18 in No. ○ Scheme is currently in the process of being constructed and guidance and modifications are still possible
3	<u>Lino Ndacada</u> Improve maize mill and turbine to be robust and strong. Add an electricity generator of up to 12 KW. To be connected to 25 nearby houses and also to run a battery charging station to benefit 50 households	<ul style="list-style-type: none"> ○ The owner is a mechanic and fabricator of turbines and mills. ○ Attitude of the owner is positive towards business expansion through selling electricity. Had already started preparing ○ Good water supply (60 l/sec) and high head (48 m) that gives adequate power to cover local demand ○ Close to a business centre with 3 rural shops and 12 houses
4	Jimi Pondo Mucheca Add an electricity generator of up to 8 KW. Connect 10 houses directly & install a battery charging station to benefit 20	<ul style="list-style-type: none"> ○ Attitude of the owner is positive towards business expansion through selling electricity ○ Water supply (20 l/sec) and high head (50 m) that gives adequate power to install a charging station for the local demand ○ Although not many houses are very close to the station

	households	more households will benefit from the battery charging station which will also increase the business.
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7) BUDGET AND COST DISTRIBUTION

The total budget estimate is Euros. Under this budget the following key aspects have been taken into consideration: technical specifications and costs for improvements and electrical generators, battery charging stations, poles and wiring for connections to nearby homesteads with cost participation by beneficiaries for poles, wiring and household connections and training of installation mechanics and operators. The budget also includes professional service providers for planning, supervision, quality control and monitoring, as well as transport, overheads and administration fees for the NGO.

Proposed Budget:

No.	Cost Item	Cost Estimate in Euros	Remarks
	INVESTMENT COSTS		
1.1	04 Improved maize mills with generators	28,000.00	Micro Financing through KSM
1.2	04 Battery charging stations	4,000.00	Micro Financing through KSM
	Subtotal	32,000.00	Revolving Fund (Operators)
1.3	Poles and wiring for connections to nearby homesteads	2,400.00	Micro Financing through KSM
1.4	Wiring and ready boards for 40 households	6,600.00	Micro Financing through KSM
	Subtotal	9,000.00	Revolving Fund (User Groups)
	Total 1	41,000.00	
	OPERATIONAL COSTS		
2.1	Training of local artisans on repair and maintenance including tools and materials – 6 in No.	2,400.00	
2.2	Training of the operators on business management – 4 in No.	1,800.00	
2.3	Transport contribution to fuel and maintenance of KSM vehicles	2,000.00	
	Total 2	6,200.00	
3	PERSONNEL COSTS		
3.1	Project Implementation Field Officer – full time employee of KSM for 1 year	3,600.00	
3.2	Professional service providers for planning, supervision, monitoring and evaluation	5,400.00	
3.3	Technical Trainer services for on the job training while upgrading the systems	2,400.00	
	Total 3	11,400.00	
4	ADMINISTRATION & PROMOTION		
4.1	Overheads and administration fees	3,000.00	
4.2	Publicity and promotion materials, posters and pamphlets	2,400.00	
	Total 4	5,400.00	

	TOTAL PROPOSED BUDGET	64,000.00	
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Other Contributions:

5.1	Estimated Local contributions	12,000.00	Unskilled labour, poles, cables, construction infrastructure
6.1	Estimated KSM contributions	15,000.00	Administration, office space, vehicles, etc.
	Total	27,000.00	

8) COST EFFECTIVENESS OF THE PROJECT

The project has the ability to reach a maximum number of households by including charging stations in the systems. All in all, the project will reach 1.590 people bringing the cost per head to 39.50 Euros. This will cover about 50% of the village.

The revolving micro financing system will have two components, one will be the revolving of the money paid by the villagers to have their houses connected directly. This fund will continue to fund further connections. The second component is the fund from the repayments by the machine owners which will be used for funding further expansion of the project into neighbouring villages like Nhamucwara where there is potential for pico- and micro-hydro projects.

9) ASSESSMENT OF POSSIBLE RISKS

There are some risks that are associated with the proposed project as follows:

- During critical dry seasons some of the water quantities from the sources might be reduced to levels that might provoke conflicts of interest between farmers who need water for irrigation and operators who need the water for running the turbines. The Field Officer has to keep constant monitoring of water situation and resolve possible conflicts through dialogue with the villagers.
- The end users are mainly farmers whose priorities are not necessarily the electricity for lighting. In the case that they have poor harvests the payment for electricity will be reduced.
- Metalurgica has limited capacity in terms of focussing on the hydro power projects. There will be need to consider involving other smaller companies from Chimoio or Manica like Savepla. Consideration should also be given to companies in the neighbouring countries like Zimbabwe who already have experience in manufacturing micro hydro turbines and generators. Examples are Taylor Engineering and Horse-Tech in Mutare and Eltex Engineering and South Wales electric in Harare. Suppliers of Micro Hydro Power machines from South Africa like BWG Hydro Power Development www.bwghydro.co.za should also be considered.

10) ADDITIONAL POTENTIAL IN THE VILLAGE

Other additional potential business that was observed during the survey and can be considered for future projects is as follows:

- ❖ Micro hydro power machines for driving fruit juice and sugar cane pressing machines. The village produces masses of different types of fruits like banana, mango, avocado, pineapples, oranges and natjies. The fruits are too many they sell at very low prices. The farmers could add value to their fruits by processing fruit juice. The farmers also produce a lot of sugar cane for the market in Manica. The demand for processed sugar is very high. Given the right equipment the farmers could process their own sugar.
- ❖ Crop drying using solar crop driers. The fruits and vegetables could also be dried using solar driers for added value.
- ❖ Micro hydro power machines for driving small scale gold panning equipment like screens and crushers. There is a lot of gold panning taking place in the village. The small scale miners could adopt small processing machines driven by hydro power in order to reduce labour.

